Force 'E' Factor

As a roller contacts the workpiece, forward motion of the cross slide combined with resistance of the float spring creates a diagonal pushing effect against the work piece. The direction of this force, as shown in Figure 1, is along a line passing through the centers of the roll and the work piece.

The diagonal force "E" is an inherent characteristic of all floating, roller-controlled tool holders of this type. At the start of the shaving operation, some sideways force is necessary. As the roller climbs the arc of the work piece toward the vertical center line, more of the force is downward. To visualize the effect consider in Figure 1 a grossly exaggerated condition in which the roll contacts the part at the "w" axis. Angle 'R' would be 90-degrees; all pressure would be sideways. When the cut is complete and the roll lies on the "x" axis, angle "C" becomes perpendicular, and no sideways force exists.

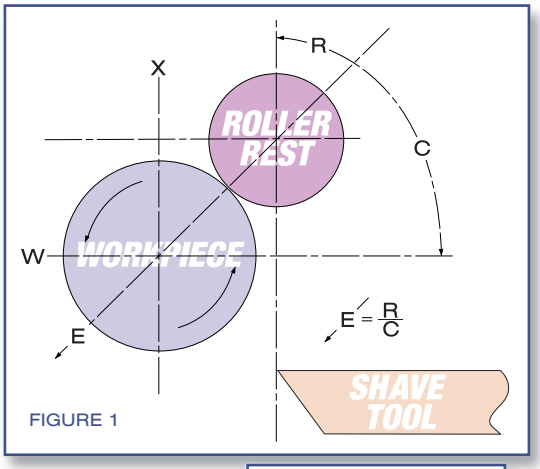

FIGURE 1

If we are to shave the best accuracy and finish, the holder must be adjusted to keep angle 'R' as small as possible. Doing so calls for use of rolls with most suitable diameter, careful adjustment of holder float height, and leaving only a small amount of stock to be shaved.

When a shaving tool gives trouble, almost always the fault lies in one of the following items, all of which have an effect on the "Force E" conditions:

1. Chattering or varying form tools in station ahead of shaving position
2. Tools or rolls not clamped tightly.
3. Cutting edge of shave tool not on tangent line of roller..
4. Shave tool contacting work piece before roller does.
5. Work length, or small diameters, requires auxiliary supporting device.

While it may be possible to accomplish short, stiff parts, Force 'E' becomes a vital factor on long shaved surfaces, or when stock diameter is small. If a fine finish is required, and tolerances are close, it is usually advisable to support the work piece opposite the shave tool in some way. On a multiple-spindle machine, a tool slide roller rest, mounted as shown in Figure 2, is probably simplest.

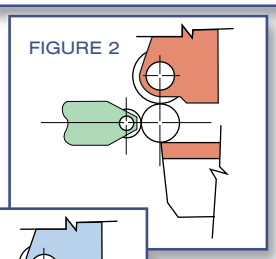
FIGURE 2

This, however, raises a problem: As the shaving decreases the work diameter, how can the support be maintained? One solution is to use a tapered roll . The smaller tapered section of the support picks up the unshaved diameter, while the larger, straight area behind takes over as the diameter decreases. Another solution is to use a carbide pad, shown in Figure 3.

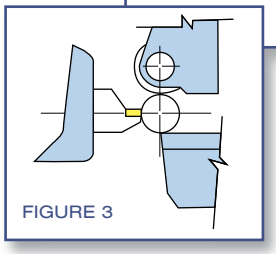
FIGURE 3

By designing the support taper correctly, and setting its holder at the proper point on the tool slide, the shaving operation can be supported throughout the operation. Under ideal conditions, no more than .010 of stock should be shaved away. However very shallow grooves or minor steps need not be designed into the forming tool; usually they can be shaved without trouble and in many cases, it is advisable to do so. On the other hand, the form should be wide enough to clear both sides of the shave tool; if it is not, the shave may rub, climb into the cut, and grab. Those who have seen this happen need no further explanation of the possible consequences.

Chatter or Vibration, from another tool in the machine, can be transmitted to a shaving tool. It should be kept in mind that a shave tool is deliberately designed to follow a previously established contour; it is not intended to round up egg shaped O.D.'s or correct eccentricity of a diameter.

If the formed surface is chattered, the shave tool roller will attempt to follow the chatter marks. For this reason, the preparatory cuts should bring the diameter to be shaved into proper condition. However, if Force E is great enough to spring the workpiece off the spindle line even briefly, it may set up the harmonic condition which produces a chattered finish. The solution, as mentioned earlier, is an outboard support, or a change in tool design, which reduces the side stress on the workpiece.